

*Course information for***Tissue biomechanics BMEN10***"Advanced Biomechanics"***Course objectives**

The aim of the course is to deepen the knowledge in biomechanics and mechanobiology of the skeletal tissues (bone, articular cartilage, tendons and ligaments) and to understand the pathomechanics of injury, adaption and degenerative changes with aging. Moreover, the course aims to provide an insight into current biomechanical research of skeletal tissues.

Responsible teacher: Hanna Isaksson (hanna.isaksson@bme.lth.se), Dept of Biomedical Engineering, BMC-D13, room D1341a, Telephone: 046 222 1749

Lecturing: Sophie Le Cann (SLC) (sophie.le_cann@bme.lth.se) available at BMC-D13, phone 046 222 0654 room D1314b, and Hanna Isaksson (HI).

Teaching assistant: Anna Gustafsson (AG) (anna.gustafsson@bme.lth.se), Elin Törnquist (ETö) (elin.tornquist@bme.lth.se), Thomas Notermans (TN) (thomas.notermans@bme.lth.se), Joeri Kok (JK) (joeri.kok@bme.lth.se), available at BMC-D13, rooms D1310b, D1312b and D1314b.

Office hours: See preliminary hours in schedule, to be arranged in class. At least one occasion after each laboratory task.

Course literature:

- Handouts: Lecture notes, research articles, book chapters and example problems.
- Assignments: One literature study assignment and two experimental and numerical laboratory assignments.

Handouts and assignments will be available on the course homepage:

<http://bme.lth.se/course-pages/tissue-biomechanics/tissue-biomechanics/>

Schedule: Please see detailed schedule on next page/under schedule.

Types of teaching: Traditional lecturing is mixed with problem solving and group exercises. Two sets of experimental and numerical laboratory assignments are included. All sessions are scheduled.

Examination: The examination of the course consists of one compulsory assignment and two laboratory reports. The assignment is performed in *groups of 2-4 students*. It includes choosing a research topic, reading, analysing and presenting the topic. It is handed in as a short summary (max 3 pages) and is presented to the other students orally at a seminar (15 + 5 min). The two laboratory parts are divided into one experimental and one numerical laboratory exercise each. For each of the two laboratory sets, one report from both numerical and experimental exercises is completed and handed in *individually* (max 10 pages).

The assignments and each of the laboratory report receive written feedback, and has to be approved for passing the course with grade 3. Assignment 1 can maximum give 20 points each, and the laboratory reports can each give a maximum of 40 points. On each assignment, 50% is required for passing the course with grade 3. The final grade of the course is based on the total number of points: Fail < 50 p. Grade 3 51-69 p. Grade 4 70-89 p. Grade 5: 90-100 p.

Schedule: Tissue Biomechanics BMEN10

W	Day & time	Place		Theme	Assignments
1	Mon 30/10 8-10	E:1328	L1	Course introduction, Bone biology, SLC	
	Tue 31/10 10-12	M:D	L2	Bone mechanics, calculations, SLC	
	Thu 2/11 10-12	E:1328	L3	<i>Practical lab information</i> , calculations AG, SLC	Hand out: Bone lab instructions
2	Mon 6/11 8-10	E:1328	L4	Degenerative bone diseases Remodelling & mechanobiology, SLC	
	Tue 7/11 10-12	M:E	L5	Cartilage biology and mechanics, HI	
	Wed 8/11 13-18	Lab	Exp	<i>Lab bone, Experimental (group 1-3)</i> ETö, SLC	
	Thu 9/11 13-18	Lab	Exp	<i>Lab bone, Experimental (group 4-6)</i> ETö, SLC	
3	Mon 13/11 8-10	E:1328	L6	Mechanical models of cartilage, calculation examples, HI	Choose A1
	Mon 13/11 10-12	Ingrid's office		<i>Office hours (Lab) ETö</i>	
	Wed 15/11 8-12 / 13-17	E:Ravel	Num	<i>Lab bone, Finite element (am or pm)</i> AG, JK	
	Thu 16/11 10-12 / 13-15	E:Ravel	Num	<i>Lab bone, Finite element (am or pm)</i> AG, JK	
4	Mon 20/11 8-10	E:1328	L7	Biomaterials for hard tissues, ETa	Due: plan A1
	Tue 21/11 10-12	E:3308	L8	Biomaterials for soft tissues, ETa	
	Tue 21/11 13-15	Ingrid's office		<i>Office hours (Lab) JK, ETö</i>	
	Thu 23/11 10-12	E:1328	L9	Degenerative joint diseases, cartilage regeneration strategies, ETa	Get feedback on A1-plan
	Thu 23/11 13-15	Ingrid's office		<i>Office hours (A1) SLC</i>	
5	Mon 27/11 8-10	E:1328	L10	Tendons and ligaments, biology and mechanics, HI	Due: Lab report Bone Hand out: Tendon lab instruct°
	Tue 28/11 10-12	M:E	S	<i>Student presentation</i> , SLC	Due: Oral A1
	Thu 30/11 10-12	E:1328	S	<i>Student presentation</i> , SLC	Due: Oral A1; Written A1
6	Mon 4/12 8-10	E:1328	L11	Total hip replacement surgery, GF, ETö	
	Wed 6/12 13-18	Lab	Exp	<i>Lab tendon, Experimental (group 1-3)</i> ETö, SLC	
	Thu 7/12 13-18	Lab	Exp	<i>Lab tendon, Experimental (group 4-6)</i> ETö, SLC	
7	Mon 11/12 8-10	E:1328	L12	Extra time	Get feedback on A1 and bone lab report
	Mon 11/12 10-12	Ingrid's office		<i>Office hours (Lab + A1) SLC</i>	
	Wed 13/12 13-17	E:Ravel	Num	<i>Lab tendon, Finite element (group 1-3)</i> AG, TN	
	Thu 14/12 13-17	E:Ravel	Num	<i>Lab tendon, Finite element (group 4-6)</i> AG, TN	
	Fri 15/12 10-12	E:C	L 11	Summary, feedback and evaluation. Research at LU & MSc projects, SLC	
	Fri 15/12 13-15	Ingrid's office		<i>Office hours (Lab) TN</i>	
	Tue 9/01 10-12	Ingrid's office		<i>Office hours (Lab) TN, ETö</i>	
	11/01/2018			Hand-in final lab-report by email	Due: lab report tendon

Type: L - Lecture
Exp - Experimental lab

S - Student presentations
Num - Numerical finite element lab

Guest lecturers:

- Biomaterials in biomechanics, **Elizabeth Tanner (ETa)**, Professor, Glasgow University, and guest professor in orthopedics, Lund University.
- Hip replacement surgery: **Gunnar Flivik (GF)**, Orthopedic Surgeon, Skåne University Hospital. Attending lecture is compulsory. If not, a one-page summary should be written about the topic.

Compulsory assignments (examination used for grading)**Assignment 1: Research topic**

Reading about a current research topic of your choice.

Students gather in groups of 2-4 people and choose a research topic. You need to find at least 5 research articles about the topic and thoroughly read them. The topic is then presented orally during 15 + 5 min in front of the rest of the class, and a written summary is handed in per group (3 pages).

Choose topic/group 13/11

Hand in plan: 20/11

Due: Oral 28/11 or 30/11

Due: Written 30/11

Laboratory 1, bone:

Due: 27/11

Practical experimental and numerical exercises related to bone mechanics.

Three-point bending test of a rat femur will be conducted in the biomechanics laboratory, followed by a practical finite element exercise where you should mimic your experimental test.

One report is completed, where you combine both exercises, including reflection and conclusions, as well as discussion of necessary assumption regarding experimental testing and the numerical modelling.

Also includes calculation problems related to bone mechanics and elasticity.

Handed in individually.

Laboratory 2, soft tissues:

Due: 11/01/2018

Practical experimental and numerical exercises related to tendon mechanics.

Tensile test of a rat tail tendon will be conducted in the biomechanics laboratory, followed by a practical finite element exercise where you should mimic your experimental test.

One report is completed, where you combine both exercises, including reflection and conclusions, as well as discussion of necessary assumption regarding experimental testing and the numerical modelling.

Calculation problems related to soft tissues, e.g. tendons including viscoelastic models is included

Handed in individually.